Space Weather Technical Forecast

Issued on Wednesday, 18 October 2023 at 01:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Weak CME arrivals possible, with a slight chance of isolated G1 Minor Storm intervals throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low, with isolated weak C-flares. Peak flare was C2.2 from a filament eruption near ex-AR3463, which produced an associated CME. There are three relatively small and simple sunspot regions on the disc, which have remained largely stable. The CME produced by the C2.2 has been assessed as largely missing Earth, ahead and south, but with a chance of a glancing interaction either late day 3 or day 4 (20-21 Oct). No other Earth-directed CMEs occurred in this period.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE were indicative of background slow wind. Wind speeds eased from 330 km/s to just below 280 km/s. Density was largely at or below average, but with a gradual increasing trend. The interplanetary magnetic field (IMF), Bt, was weak, less than 3nT. The north-south component, Bt, was also weak varying -2nT to +3nT. Phi angle was negative (towards the Sun) but rotated to positive (away from the Sun) around 17/2200 UTC. Geomagnetic activity was Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at Background. GOES16 high energy (greater than 2MeV) electron flux was at Background throughout. Associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observation at 18/0000UTC was 1.99e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Very Low activity expected at first. There is a slight, but perhaps increasing chance of isolated M-flares through the period, as any development occurs.

Solar Wind / Geomagnetic Activity: There are four CMEs with potential Earth-directed components currently analysed. Two from filament eruptions on the 14th are low confidence, but may combine to give a single glance during the morning of day 1(18 Oct). A glancing impact is also possible late day 2 or early day 3 (19-20 Oct) from the CME originating with the C7.5 flare on 16 Oct, however the bulk of the material from this CME is expected to miss behind. The filament eruption CME from 17 Oct then gives a slight chance of a glancing impact day 3 -4 (20-21 Oct). Otherwise, slow wind conditions are expected to dominate day 1-2, before a likely transition into the fast wind of CH62/- day 3. This is a small and weak feature however, with any enhancement likely to be limited, easing again day 4 (21 Oct). Overall, mainly Quiet geomagnetic activity is expected but with the potential for Unsettled to Active spells, with a very slight chance of G1 Minor storm intervals from any enhancements. The greatest risk is either late day 2 or day 3 (19-20 Oct) if the third CME arrival combines with any CH62/- enhancement.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux will most likely remain at Background levels. High energy electron flux (greater than 2MeV) is expected to be at background levels day 1, perhaps rising to Moderate depending on the strength of any enhancement that occurs. The associated 24 hr electron fluence is expected to remain below Active (1e8 integrated pfu)

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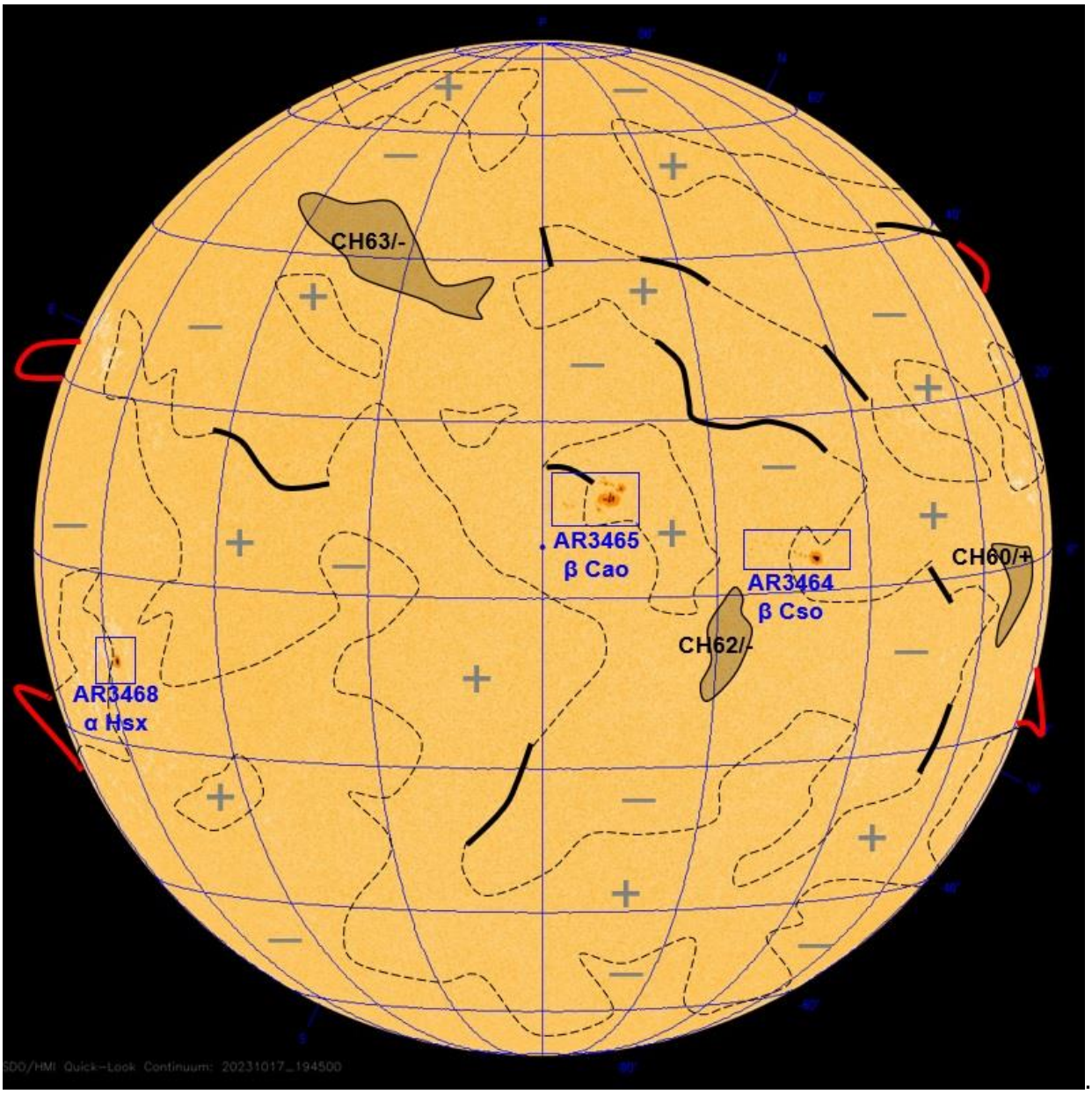
Figure 1. Solar Analysis Valid *.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are a number of weak CMEs with the potential to glance Earth through the period.

The first two are both low confidence but have a chance to arrive during the first half of day 1 (18 Oct), most likely as a single arrival. The first is from a corona-based dimming near N35W030 starting around 14/0340UTC. The second from a CME observed due to a filament lift-off north of AR3466 at 14/1240UTC, around N15W025.

A third CME was observed from the C7.5 of AR3467 in the northeast disc on 16 Oct. This is also low confidence, with the bulk of the material missing behind Earth, but with the chance of a slight glance either late day 2 or more likely early day 3 (19-20 Oct). A fourth CME was also observed from a filament eruption near ex-AR3463 off the southwest disc early on 17 Oct. This is also expected to largely miss Earth, time ahead of Earth, but with the potential for a glancing impact either late on day 3 or day 4 (20-21 Oct).

Slow wind conditions have persisted at Earth, with any influence of CH60/+ fast winds, which had been forecast to arrive 16-17 Oct, now looking to be either weak or missing. The next coronal hole enhancement is likely to be from the small feature CH62/-. This is another small feature, and unlikely to bring significant solar wind enhancement, however fast wind onset is most likely on day 3 (20 Oct). There is some potential that this may increase any impact from any coincident CME, however this is also very low confidence.

Overall, mainly Quiet geomagnetic activity is expected. However there is the potential for activity to increase due to the CME arrivals, and the onset of CH62/- fast winds. This brings the potential for Unsettled to Active spells, with a very slight chance of G1 Minor storm intervals. The greatest risk is either late day 2 or day 3 (19-20 Oct) if the third CME arrives coincident with any CIR head of CH62/-, or within any associated fast wind.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	10	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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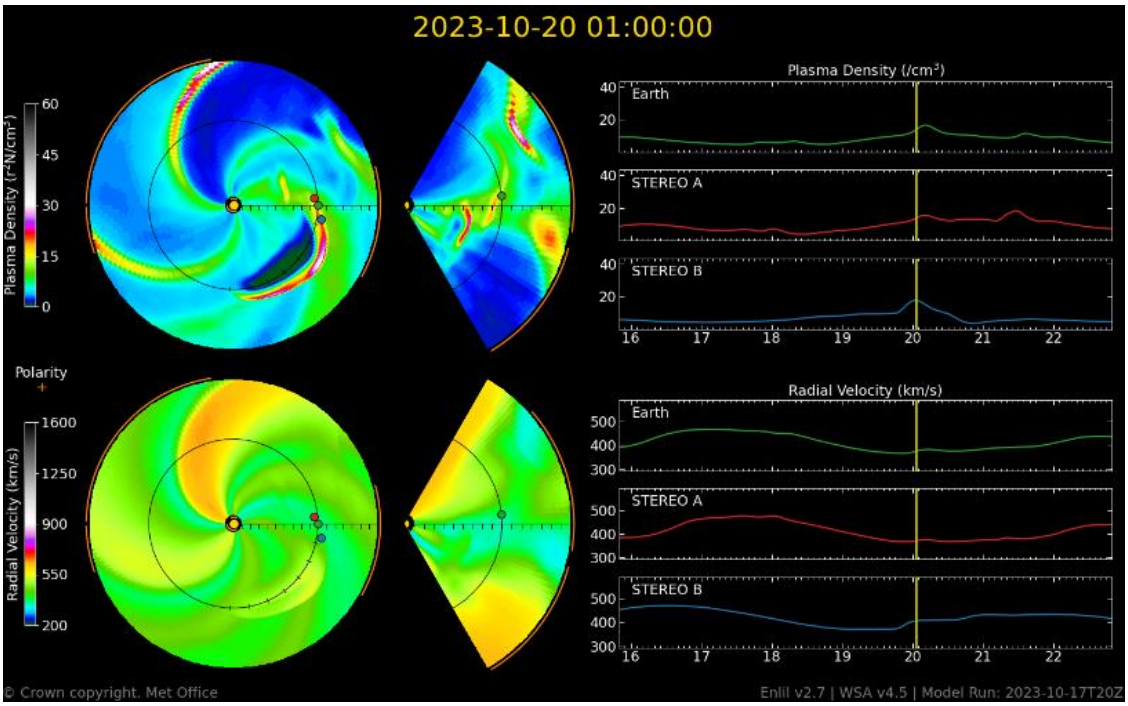
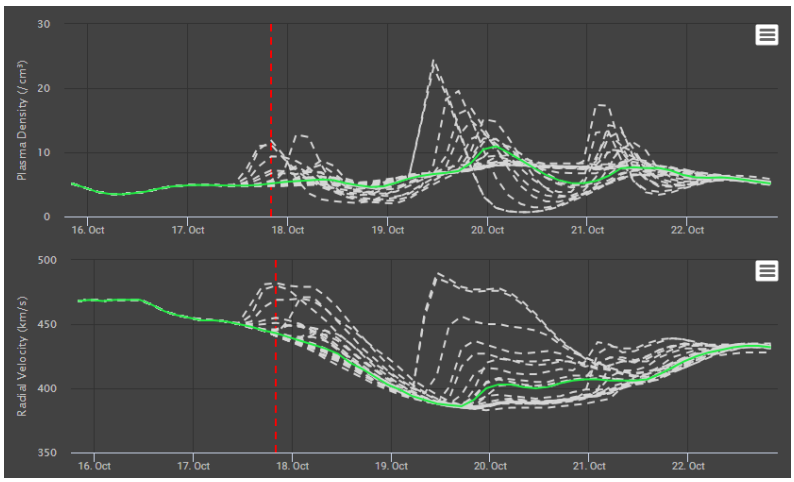
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time	Comments
14/1337	Partial	Filament	NW	448	18/0900	Low confidence. Glance
14/2152	Partial	Filament	NW	431	18/0900	Low confidence Glance
16/1730	Partial	C7.5 AR3467	NE	680	20/0100	Low confidence Glance
17/1430	Partial	Filament	SW	420	21/0600	Low confidence Glance

Figure 2: Enlil and ensemble, showing a variety of weak enhancements throughout.





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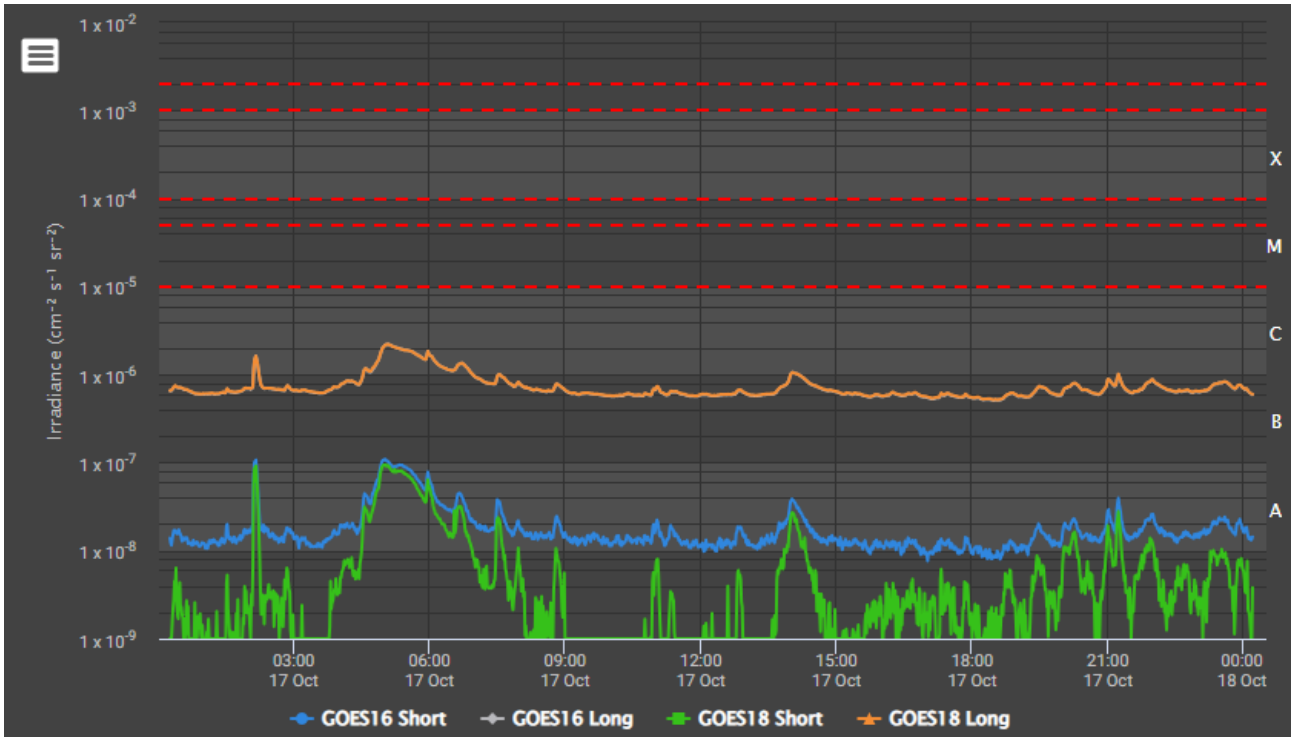
Radio Blackouts - X-Ray Flares:

Activity is expected to remain Low to Very Low, with only isolated C-class flares likely in the absence of any further sunspot, development. There are three numbered sunspot regions, all of which remain small, simple and stable. A couple of plage regions, including in the northeast disc, may allow for some development.

While there is only a very slight chance of activity increasing to Moderate from the occurrence of any M-flares, this risk is increased slightly through period as some development is likely to occur.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	10	20	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16/18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is most likely to persist at Background levels. Any increase to proton flux is unlikely, given the current visible sunspot activity.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

Electron flux observed by GOES-16 at GEO is currently at background. There are a number of solar wind enhancements possible through the period, mainly due to any CME arrivals throughout the period or the small coronal hole CH62/- fast wind, most likely day 3 (20 Oct). These are all low confidence however, and an enhancement is expected to be largely weak. These may increase electron populations through the Van Allen belts at times, which could bring periods of Moderate flux, most likely towards the end of the period.

The associated 24 hour fluence is expected to remain below the Active threshold, although an increasing trend is likely, especially towards the end of the period, depending on the strength of any enhancements that occur. This is supported by REFM, however this will only provide good guidance in the absence of any CME or fast wind enhancements.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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